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COVER: Pediatric nurse practitioner Cindy Trent examines Audrianna Van Tassel, an 11-month-old with fever in the non-urgent wing of the Children's Emergency Unit of the Charette Health Care Center at NMC Portsmouth VA. Last April NMC Portsmouth became the first U.S. military health facility to open a children's emergency unit. Photo by HM2 Martha Hopkins. Story on page 1.

NMC Portsmouth Opens First Military Children's Emergency Unit

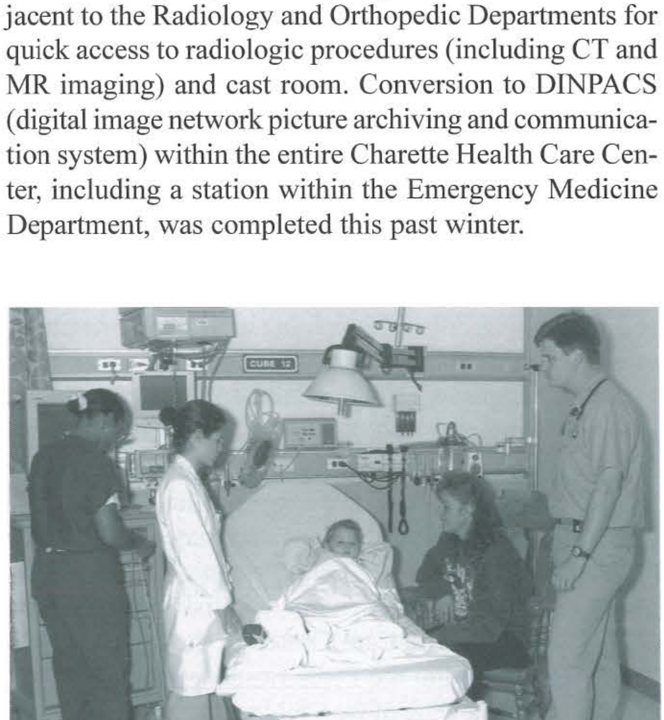
CDR Mark Ralston, MC, USNR

On 10 April 1999, Naval Medical Center Portsmouth, VA, became the first U.S. military health facility to open a children's emergency unit. Recognizing the need to provide ill or injured children with age-appropriate services and staff trained for pediatric health emergencies, the Navy set aside space for the Children's Emergency Unit within the Emergency Medicine Department of the new Charette Health Care Center.

The command initiated a regional marketing effort to promote the Children's Emergency Unit with posters and brochures. As of September 1999, parents who phone the Nurse-Line (Health Care Information Line of OPTUM, McLean, VA) for medical advice have been instructed to utilize the new Children's Emergency Unit for non-911 emergencies within the Tidewater area of Virginia.

Features of the Children's Emergency Unit include a two-bed resuscitation room, four to six monitored acute care beds, a separate three to six-bed wing for non-urgent care, treatment room, child life services, inner waiting room with TV/VCR for patients pending discharge, and access to the Emergency Medicine Department's three-bed 23-hour Observation Unit (which opened on 7 October 1999). The Children's Emergency Unit is fully equipped for conscious sedation procedures, which have been performed primarily for endoscopy, laceration repair, and fracture reduction.

The Emergency Medicine Department is situated adjacent to the Radiology and Orthopedic Departments for quick access to radiologic procedures (including CT and MR imaging) and cast room. Conversion to DINPACS (digital image network picture archiving and communication system) within the entire Charette Health Care Center, including a station within the Emergency Medicine Department, was completed this past winter.



LT Marcia Parra (pediatric chief resident), LT Mark Eich (emergency medicine resident), and Beverly Spivey (pediatric nurse) attend to Alan Mott, a 5-year-old with VP shunt and headache, in one of the urgent beds in the Children's Emergency Unit.

Table 1. Curriculum in pediatric emergency medicine (PEM) at Naval Medical Center Portsmouth

	Pediatrics	Emergency Medicine
PGY 1	*4 wk general Ed rotation *4 wk pediatric ED rotation *Monthly peds mock code *PALS provider/instructor *General PEM lectures	*4 wk general ED rotation *General PEM lectures
PGY 2	*4 wk pediatric ED rotation *Monthly peds mock code *Life support lab *General PEM lectures	*1 mo pediatric ED rotation (CHKD) *Shifts in Peds Emergency Unit *Bimonthly peds mock code *Monthly life support lab *PALS provider/instructor *General PEM lectures
PGY 3	*Monthly peds mock code *4 wk rotation in busy pediatric ED outside NMCP *PEM Update Conference *General PEM lectures	*Shifts in Peds Emergency Unit *Monthly peds mock code *Monthly life support lab *General PEM lectures
PGY 4		*Shifts in Peds Emergency Unit *Monthly peds mock code *Monthly life support lab *General PEM lectures

The Children's Emergency Unit is staffed with physicians, nurses, and nurse practitioners trained in pediatric emergency medicine and nursing. Three pediatric nurses and three pediatric nurse practitioners were hired through a resource sharing contract with Spectrum Healthcare Resources (St. Louis, MO) designed primarily to recapture patients formerly using non-MTF providers in the Tidewater area of Tricare Mid-Atlantic Region 2. Spectrum Healthcare is a subcontractor of the Anthem Alliance Insurance Company, the command's managed care support contractor.

Care of urgent and emergent pediatric patients is the 24-hour responsibility of the attending pediatric emergency physician in the Department, one of whom (author) is a pediatrician with fellowship training in pediatric emergency medicine and is the Director of the Unit.

The non-urgent wing of the Children's Emergency Unit is open 16 hours/day (0800-2400) and is staffed by a team of pediatric nurse practitioners. Currently, over half the patients visiting the Unit are triaged as non-urgent. Tricare Prime enrollees left without a primary care manager as a result of the 1 October 1999 dissolution of the Navy's Tidewater contract with Sentara, will likely be absorbed at the Charette Health Care Center by the Tricare Prime Clinic located within the Pediatrics Department as well as the non-urgent wing of the Children's Emergency Unit.

The Children's Emergency Unit is a training site in pediatric emergency medicine for house staff and medical students. House staff from Pediatrics and Emergency Medicine residency programs rotate through the Children's Emergency Unit as illustrated in Table 1.

All interns at Naval Medical Center Portsmouth complete a 4-week rotation in the Emergency Medicine Department during which they are assigned shifts within the Children's Emergency Unit. Pediatric interns complete a separate 4-week pediatric emergency medicine rotation, currently located at Children's Hospital of the King's Daughters in Norfolk. This rotation will be moved to the Children's Emergency Unit in the Charette Health Care Center on 1 July 2000.

Pediatric mock codes for pediatric and emergency medicine residents, nurses, and respiratory therapists are scheduled monthly in the Children's Emergency Unit. The codes are run by the house staff, who utilize a team approach to code organization and gain repetitive experience in pediatric resuscitations. A staff critique concludes each mock code. For both real as well as mock codes, the Children's Emergency Unit organizes its equipment into three identical Broselow carts (with color-coded drawers based on the Broselow system of patient weight by length correlation).

Second-year pediatric residents spend a separate 4-week rotation in the Children's Emergency Unit during which they work a minimum of 20 8-hour shifts. Features of this rotation include a topically oriented syllabus in pediatric emergency medicine, life support lab (intraosseus line placement, needle and surgical cricothyroidotomy, chest tube thoracostomy, chest thoracotomy, pericardiocentesis, repair cardiac puncture wound, diagnostic peritoneal lavage, venous cutdown, and live ferret intubations), journal club, and preparation and delivery of one lecture on a topic pertinent to pediatric emergency medicine to Emergency Medicine Department interns.

Third-year pediatric residents interested in pediatric emergency medicine are encouraged to spend a 4-week rotation in a busy pediatric emergency department out-

Table 2. Pediatric Clinical Practice Guidelines currenty in use in Children's Emergency Unit, Naval Medical Center Portsmouth

Fever Without Source in Previously Well Child Aged 0-36 Months	New Onset Diabetes Mellitus (including DKA)
Fever/Neutropenia	Septic Arthritis
Fever/Sickle Cell	Pelvic Inflammatory Disease
Pain/Sickle Cell	Hyperbilirubinemia
Asthma	Osteomyelitis
Bronchiolitis	CNS Shunt Malfunction
Croup	Physical & Sexual Abuse
Acute Gastroenteritis	Septic Shock
First Simple Febrile Seizure	Head Injury
Status Epilepticus	Animal Bites
Urinary Tract Infection	Wound Management
Meningitis	Dental Trauma
Otitis Media & OME	Acute Scrotal Swelling
Pneumonia	Airway & GI Foreign Body
Pleural Effusion	Vaginal Bleeding
Acute Poisoning	Inborn Error of Metabolism

side Naval Medical Center Portsmouth, ideally to include some exposure to toxicology at a regional poison center.

Emergency medicine residents regularly work shifts in the Children's Emergency Unit and attend the monthly life support lab throughout their training (PGY 2-4 years) at Naval Medical Center Portsmouth. They complete a 1-month pediatric emergency medicine rotation at Children's Hospital of the King's Daughters in their PGY-2 year.

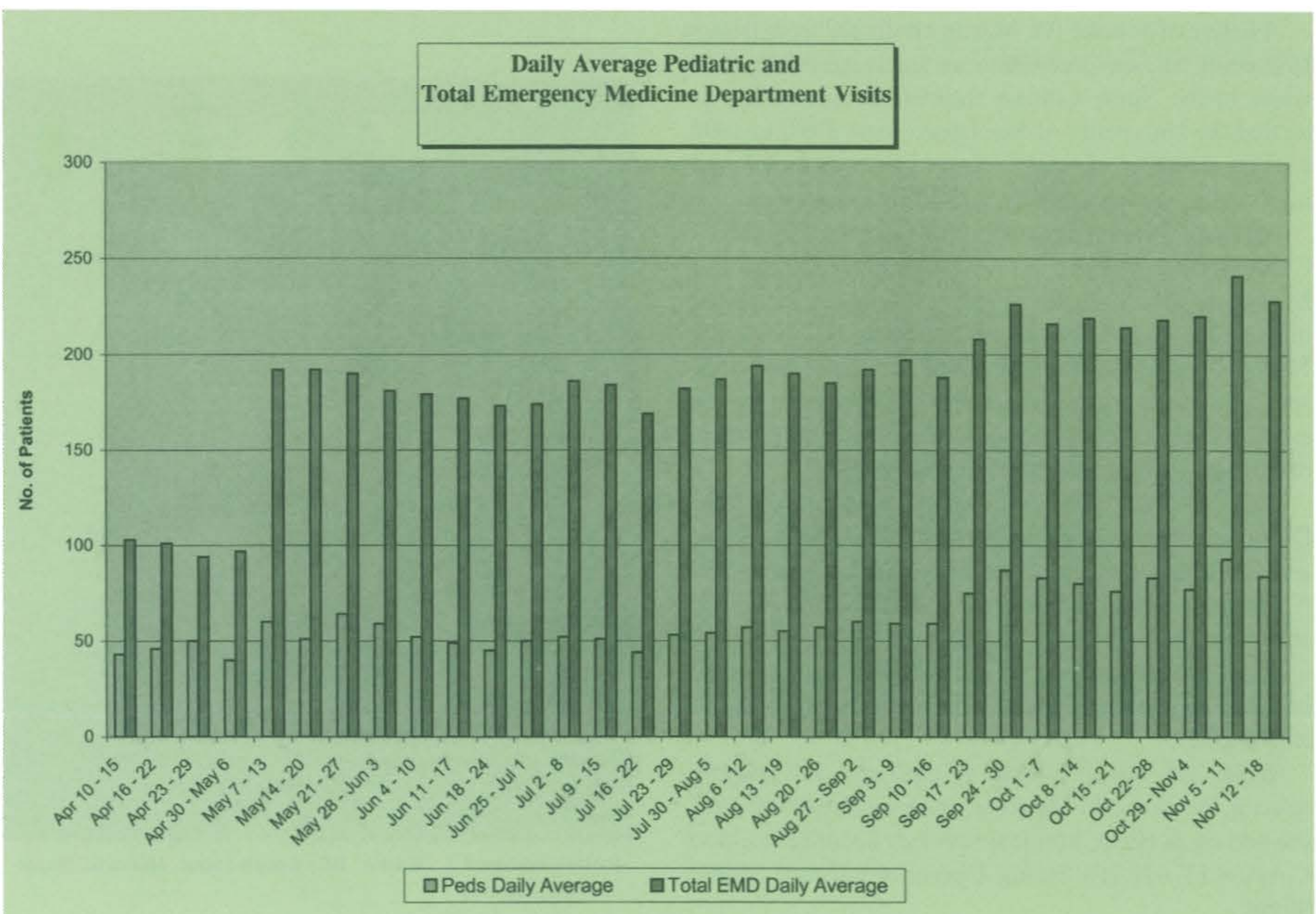
Both pediatric and emergency medicine residents are scheduled to complete the PALS provider/instructor course. A variety of general lectures in pediatric emergency medicine are given within both Pediatrics and Emergency Medicine Departments.

The Children's Emergency Unit is supported by the Charette Health Care Center's new Pediatric Intensive Care Unit, which opened on 16 August 1999 with a staff of three pediatric intensivists. The PICU has now expanded to a capacity of six beds. Both pediatric and emergency medicine residents have scheduled rotations in the PICU. Additional support is provided by a full complement of pediatric medical and surgical subspecialists (several on full-time staff at Children's Hospital of the King's Daughters).

The Children's Emergency Unit coordinates pediatric care with the Pediatrics Department within the Charette Health Care Center. Areas of coordination include referral of urgent/emergent patients during regular hours from Pediatrics to the Children's Emergency Unit, after hours care for Tricare Prime enrollees, routine referral of all asthmatics treated in the Children's Emergency Unit to the Pediatric Pulmonology Clinic, and development of clinical practice guidelines. Pediatric practice guidelines currently in use in the Children's Emergency Unit are listed in Table 2.

All Department of Defense beneficiaries 18 years and under are eligible for care in the Children's Emergency Unit. Average daily census for the Emergency Medicine Department as well as for the Children's Emergency Unit is illustrated in Table 3. Use of the Children's Emergency Unit in its first year is currently projected to exceed 25,000 visits. ❑

CDR Ralston is Director of the Children's Emergency Unit, Naval Medical Center Portsmouth, VA.



Leadership Changes Hands at the National Naval Medical Center

RADM Kathleen L. Martin, NC, Director of the Navy Nurse Corps added the title Commander, National Naval Medical Center in a change of command ceremony on 18 November 1999, at Bethesda, MD. Martin relieved RADM Bonnie B. Potter, MC, whose new assignment is Fleet Surgeon, Commander-in-Chief, Atlantic Fleet, Norfolk, VA.

A native of Arnold, PA, Martin graduated from Boston University and was commissioned an ensign in May 1973 while in the Nurse Corps Candidate Program. She attended the University of San Diego from 1990 to 1992, earning a master of science degree in both nursing administration and as a family health nurse specialist.

RADM Martin assumed her first command in 1993 as Commanding Officer of Naval Medical Clinic, Port Hueneme, CA. She subsequently served as Commanding Officer, Naval Hospital, Charleston, SC, from July 1995 to June 1998. She was assigned as the Medical Inspector General from August 1998 to October 1999, and assumed her current position as the nineteenth Director of the Navy Nurse Corps in August 1998.

RADM Potter served at Bethesda since July 1997. During her tenure she also served as Chief, Medical Corps and Chairman, Region 1 Tricare Executive Board (Lead Agent). A native of Piedmont, CA, RADM Potter graduated from the University of California at Davis in 1968 with a bachelor's degree in animal science. She earned her M.D. degree from St. Louis University School of Medicine in 1975.

While assigned at NNMC as chairman and program director, Department of Internal Medicine from 1989-1993, she served as Head, Medical Services aboard the USNS *Comfort* (T-AH 20) during Operations Desert Shield/Storm.

RADM Potter is a fellow of the American Academy of Physicians and holds faculty appointments at both the Uniformed Services University of the Health Sciences, Bethesda, MD, and Georgetown University of Medicine, Washington, DC. ❑

—Story by Kevin Sforza, NNMC Public Affairs

RADM Kathleen L. Martin, NC, Commander, National Naval Medical Center

Armed Forces Institute of Pathology Collaborates to Improve Body Armor

Photos by David Miles, Medical Audio Visual Services (WRAIR)

AFIP Director CAPT Glenn Wagner, MC, USN (right) gets a body armor project update from participating AFIP staff members (left to right) MAJ Steven Campman, USAF, MC; MAJ Peter Schilke, USAF, MC; Frank Gannon, MD; and CDR Marlene DeMaio, MC, USNR.

Military body armor is designed to protect the service member on the front lines from death or injury from bullet penetration. But that is not the end of the story. Consider what happens "behind the armor." That is what CDR Marlene DeMaio, MC, USNR, of AFIP's Department of Orthopedic Pathology and associates are looking into as they perform their biomechanical evaluation of chest body armor and its part in combat survivability of Marines and Soldiers. The project is a collaboration between AFIP, the Uniformed Services University of the Health Sciences (USUHS), U.S. Army Soldier's Systems Command, and National Naval Medical Center (NNMC). The study, which looks at the effects of blunt trauma to the chest, or "behind body armor" effects, has provided significant findings on lethality, injury thresholds, and injury patterns associated with nonpenetrating ballistic impact to armor-protected thoracic sites.

The Society of Military Orthopedic Surgeons recognized the importance of the project and its bearing and impact on care of military members in combat as it presented the organization's Founders' Award for Best Military Relevant Paper to Dr. DeMaio and associates for their paper, "Biomechanical Evaluation of Chest Body Armor." Other contributors to the study were MAJ Peter Schilke, USAF, MC, and MAJ Steven Campman, USAF, MC, both of AFIP's Office of the Armed Forces Medical Examiner; five U.S.Navy doctors; an Aberdeen Proving Ground, MD, test engineer; and the overall project engineer from the U.S. Army Research, Development, Test and Evaluation (RD&E) Center, Natick, MA. The award was presented at the Society's 41st Annual Meeting in Williamsburg, VA, in October.

"It is well known but poorly recognized that a high percentage of combat injuries are orthopedic," said Dr. DeMaio. "Some 80 percent of survivors in armed conflict have wounds that require orthopedic surgery." Before joining the Navy, Dr. DeMaio received her surgical training at New Haven Hospital, Yale University, in the Department of Orthopedic Surgery (general surgery with a heavy concentration in trauma surgery), followed by a 2-year fellowship in sports medicine and injury at the Cincinnati Sports Medicine and Orthopedic Center. "I could be looking at sports gear, but I would rather be doing this," said Dr. DeMaio.

The body armor project is part of an effort to develop a military version of the National Institute of Justice (NIJ) test protocol for civilian body armor. Based on experimental work more than 20 years old, NIJ Standard 1010.03 remains the current standard for civilian law enforcement chest body armor. Individual personnel armor currently produced to these specifications was adopted by the military for use by combatants and military police. Projectile velocities have increased tremendously, and the types of threats to military personnel have increased in severity, with the military services now more focused on preparation for "urban warfare"--close quarters conflicts in alleys, warehouses, and even business districts as opposed to the open-plains warfare of the 1991 Persian Gulf War. When a combatant is fired upon at close range, the body armor must offer protection equal to today's threat.

Marines wear the new military body armor beneath their camouflage utilities.

The automotive industry's research that led to its production of the crash test dummy set a precedent for the type of biomechanical testing pursued in the body armor study. Automotive engineers studied accidents in which a steering column caused blunt injury to the chest. In military chest body armor tests, the projectiles are supersonic, the load imparted to the chest is huge, and the impact is extremely difficult to measure. "We want to take the basic scientific data from our study and do what the Society of Automotive Engineers did when they developed the crash test dummy, but ours will be a ballistics dummy," said Dr. DeMaio.

For the body armor study, live fire tests were performed on armor-protected test specimens at an Aberdeen, MD, test range. Soft armor with removable plates, such as that in use by civilian law enforcement agencies and the military, was used for all tests in the study. The armor was tested alone or with one of two different plates. Project Engineer James Mackiewicz of the U.S. Army RD&E Center, Natick, designed the test plates and determined the projectile velocities based on threats the military is likely to encounter.

As an essential part of the study, OAFME forensic pathologists Drs. Schilke and Campman performed full forensic autopsies of the armor-protected test specimens after impact of the test shots to provide assessment of the nature and full extent of the injuries in a standardized format. To evaluate the effectiveness of the armor, the types and severity of the injuries were recorded, as well as biomechanical factors associated with trauma, such as accelerations of the chest and important organs, pressures in the heart and thoracic cavity, and loading to the impact site. Photographs and computerized tomography (CT) scans were done before and after the shots.

Recognizing the military significance of the study, AFIP Director, CAPT Glenn Wagner, MC, USN, appointed Drs. Schilke and Campman to the project in mid-1998. "They were very enthusiastic and have contributed greatly," Dr. DeMaio said. "I rely heavily on their input and assessments. I could not do the study without them."

Francis Gannon, MD, an orthopedic pathologist and metabolic bone expert in AFIP's Orthopedic Pathology Department, correlated the number and kind of fractures caused by test projectiles with the bone density of the specimens used in the study. CDR Steven Parks, USN, a nuclear and mechanical engineer and consultant to AFIP, incorporated state-of-the-art instrumentation and methods to collect and compile relevant data to quantify and describe the effects of each microsecond-long firing event at the Aberdeen range.

The body armor project has proceeded with an extraordinarily low budget because the other military institutions involved provided labor, medical equipment, and use of their facilities at absolutely no charge, Dr. DeMaio said. "For example, an NNMC cardiac surgeon spent untold hours with us (about 17 days)," she said, "and we made use of NNMC's various departments and the medical school."

The body armor study and ongoing research project exemplify the positive results that can be achieved when some of the best military medical researchers and clinicians collaborate on a winning idea--redefining the standards of the protective equipment military combatants wear in order to save their lives. "For our frontline men and women, it is our obligation to use the best science we have to assure a high-impact armor system," said DeMaio. "It is people who fight wars, people on the front lines and on dangerous peacekeeping missions in various hot spots. They are out there one-on-one—walking targets. It is our job to protect them." ❑

—Story and photos by Ann Ham, Armed Forces Institute of Pathology Public Affairs, Washington, DC.

New Army-Navy Medical Research Facility Supports Sailors, Marines, Soldiers, and Airmen

"... we must keep clearly in mind the fact that we are winning the present war not because our troops are courageous and well-equipped, but because of the effective measures that have been taken to keep them healthy and fit to fight."

– Brig. Gen. James S. Simmons, 1944 (*Panel 7)

For over 57 years, one of the Navy's largest biomedical research laboratories called the campus of the National Naval Medical Center, Bethesda, MD, home. Since 1942, the laboratory conducted research into a variety of diseases and operational problems affecting the health, safety, performance, and readiness of Sailors and Marines. In October 1999 the Naval Medical Research Center (NMRC), the former Naval Medical Research Institute (NMRI), began moving to a new location and now jointly resides with the Walter Reed Army Institute of Research (WRAIR) at the ninth largest biomedical laboratory in the United States located at Forest Glen, MD. The Navy and Army bring a notable collection of achievements to the new facility.

"The cornerstone of medical care in the Navy is basic research."
– CAPT Albert Behnke (*Panel 10)

NMRC brings a history of extraordinary medical research successes to the new facility. When manned space flights were an adventure, not a routine, then NMRI researchers trained America's first astronauts. Scientists at the laboratory went on to organize the world's first tissue bank, perfect an early version of the heart-lung machine, and desalinate seawater. They also developed protective clothing (immersion and exposure suits, flight goggles, and safety belts), physiological telemetry technology, and the high-speed dental drill. During the last decade Navy researchers explained the function of the T-cell costimulatory receptor, referred to as the *Holy Grail* of immunology, and developed the techniques for growing human T-cells and bone marrow stem cells in the laboratory. An experimental bone marrow cell growth system for use on the battlefield went aboard one of the space shuttles. NMRC scientists also developed hand-held assays to identify biological warfare agents, documented the immunogenicity of the first oral campylobacter vaccine, and completed the first genomic sequence of the malaria chromosome.

WRAIR began as the Army Medical School in 1893 and evolved into a world class research organization with a rich history of successes which include field treatments for infectious diseases and chemical injuries, and the first research in comparative ballistics. Army researchers made major advances in the preservation, shipment, and typing of whole blood and in the use of plasma for treating hemorrhagic shock. During World War II Army researchers played key roles in the development of a typhus vaccine, field testing of penicillin, and advances in trauma surgery. WRAIR scientists have developed and tested vaccines against hepatitis A, HIV, Japanese encephalitis, and malaria. They also developed a device to monitor intensively critically injured casualties during transport and are currently testing agents to counteract the effects of sleep deprivation in prolonged combat.

Building on this rich legacy, the Navy/Army team at the new facility will continue to be the vanguard of biomedical research. Current Navy research efforts focus on four broad areas – combat casualty care, biological warfare defenses, infectious diseases, and bone marrow research.

Combat Casualty Care

> ***"There must also be on the spot excellent doctors, skilled in healing wounds and extracting missiles, equipped with appropriate medicines and instruments and provided by the city with ointments, honey, bandages and lint, not only to prevent the wounded from dying but also to render them, having rapidly recovered their health, useful in subsequent encounters, being ready to court danger in the knowledge that they had been healed and well looked after."***
>
> **– Philo of Byzantium, 3rd century BC (*Panel 7)**

The Combat Casualty Care program consists of six interrelated areas of research: decompression, oxygen toxicity, thermal stress, immune cell biology, resuscitative medicine, and transfusion and cryopreservation. Multi-disciplined teams of researchers are investigating ways to care for and protect deployed troops. They are looking for new ways to accelerate decompression safely after long deep dives, as well as preventing and treating decompression sickness to support Navy divers in the fields of Explosive Ordnance Disposal, Naval Special Warfare, Fleet Submarine, and Diving. Scientists are looking into the complications of breathing pure oxygen under pressure. Other team members are providing recommendations to the operational community to improve both physical and cognitive performance in harsh environments. Researchers are actively pursuing new therapeutic strategies to overcome the immune rejection that prevents organ transplantation in the treatment of injuries, casualties, and disease. Research also focuses on the mechanisms responsible for cell death during hemorrhage and developing interventions to promote casualty stabilization and life

Attending the facility's opening last fall were (left to right) Senator Daniel Inouye, VADM Richard Nelson, Surgeon General of the Navy, Senator Paul Sarbanes, and LGEN Ronald Blanck, Surgeon General of the Army.

support. Other researchers are looking for ways to automate blood collection, separation, and storage.

Biological Warfare Defense

> ***"Whether or not gas will be employed in future wars is a matter of conjecture, but the effect is so deadly to the unprepared that we can never afford to neglect the question."***
> **– Gen. John J. Pershing, 1920 (*Panel 9)**

Navy researchers are leading the way in rapid and confirmatory diagnostics and detection of biological warfare (BW) agents. Research products already delivered to the fleet include hand-held assays that can identify a variety of BW threat agents in minutes. These assays identify a range of infectious BW agents and toxins in clinical and environmental samples. The researchers continue to improve on current assays and work to develop new ones. Beyond the hand-held assays, they are developing biosensor-linked automated systems that will increase sensitivity and decrease assay time. The research team also developed a rapidly deployable laboratory to support them for onsite identification of suspect agents using microbiological, immunological and molecular identification techniques.

Infectious Diseases

> ***"The recruits that have joined us ... are afflicted with measles, camp fever, etc., so that instead of being an advantage to us they are an element of weakness."***
> **– Gen. Robert E. Lee (*Panel 7)**

The Infectious Diseases program is the largest research effort at NMRC. The research emphasis is on the development of preventive vaccines and improved diagnostic tests for infectious diseases of military importance such as malaria, diarrheal diseases, and viral and rickettsial diseases. Malaria is a serious threat to the health and operational readiness of deployed troops. The malaria program has two primary efforts, one to develop

CAPT Richard G. Hibbs, Jr., MC, USN, NMRC Commanding Officer (left), COL Martin H. Crumrine, MSC, USA, WRAIR Commander, are working together at the new research facility.

preventative vaccines and another to sequence the genome of *Plasmodium falciparum*.

Diarrheal disease is one of the most common medical problems encountered by deployed personnel. During Operation Desert Shield, data collected by the forward deployed laboratory in Saudi Arabia over a 3-month period indicated that over 50% of U.S. ground personnel experienced at least one episode of diarrhea, with 1 in 5 losing duty time because of their illness. The leading bacterial causes of diarrhea are *Campylobacter* and enterotoxigenic strain of *E. coli*. Researchers are developing and testing new methods to diagnose treat and prevent these illnesses. Currently researches are working jointly with the Army to develop a combined vaccine.

Another team of researchers is working on dengue fever, scrub typhus, and epidemic typhus. They are developing dengue and typhus vaccines using the new DNA vaccine technology and using molecular biology techniques to clone live, attenuated viruses. They are also adapting rapid diagnostic tests for scrub and epidemic typhus for field hospital settings.

Bone Marrow Research

> ***"It is given to but few scientific men today to lay bare a secret of nature materially affecting the prosperity of nations, and the lives, fortunes, and happiness of thousands. Fewer still succeed in so quickly convincing brother scientists and men in authority of the truth of their discoveries, that their eyes behold the glorious results."***
>
> **– Brig. Gen. Walter Drew McCaw (*Panel 8)**

The Navy's bone marrow research efforts provide military contingency support for casualties with marrow toxic injury due to radiation or chemical warfare agents. Also, the Navy is the executive agent for the C.W. "Bill" Young Marrow Donor Recruitment and Research Program (The Department of Defense Marrow Donor Program). In 1986 the Navy initiated federal support for the National Marrow Donor Program. This research team has provided innovations that are transforming genetic testing to a highly reliable and cost-effective DNA-based technology. Their work is making unrelated donor marrow transplantation practical. They also recruit and medically support DOD marrow donor volunteers. Last fall this group assisted the U.S. Forces Japan Bone Marrow Registration Drive held on U.S. bases throughout Japan and over 4,000 volunteers registered. Onboard the USS *Pearl Harbor*, a lieutenant became the 200,000th marrow donor volunteer.

474,000 Square Feet of Flexibility

Navy and Army scientists worked with the architect in designing a building for biomedical research, a building that will change as the military's biomedical research requirements change. The facility was built from the ground up to represent the best and most useful ideas in work-center design, internal communication, biomedical laboratory design, and interfaces between scientific disciplines and technologies. At the heart of the building are the laboratories. The outer steel frame of the building allows the inner walls to be easily moved and the office and laboratory spaces reconfigured. Another reason this is possible is that between each research floor is a 9-foot-high maintenance floor that houses telecommunications capability, electric wiring, pipes, and other utilities. There are 125 spacious laboratories filled with natural light for Navy and Army scientists and technicians to work together side by side. Nearly 1,000 active duty military and civilian scientists and support people will work in the new building when it is fully staffed. The building includes a wonderful research library, one fixed and two portable video-teleconferencing units, an auditorium, meeting rooms and classrooms, and ample office space.

*The quotes are from the 10 granite and tile historical panels that line the main corridor of the new facility. Three of the panels celebrate the lives of key people in the history of WRAIR and NMRC: MAJ Walter Reed; BGEN George Sternberg (founder of the Army Medical School, which became WRAIR); and CAPT Albert R. Behnke (whose research and initiative laid the ground work for the Navy's first biomedical laboratory in support of field operations). The remaining seven panels are dedicated to the Navy and Army research programs. The story of military medical research, its challenges and triumphs is told through pictures set in tile and quotes carved in stone. ❑

—Story by Doris M. Ryan, Medical Research and Development Division (MED-26), Bureau of Medicine and Surgery, Washington, DC.

Navy Medicine's "Spring Fling"

LCDR David R. Lavender, MSC, USN
LCDR David P. Gray, MSC, USN

The amphibious landing is under way. The din is horrendous. Explosions rip the air continuously. Landing Craft-Air Cushion (LCAC) rush to the shore, disgorge their precious cargo, and return to the erupting sea for another load. Amphibious Assault Vehicles (AAV) climb out of the surf and roar across the beach, eager in their search for the origin of the shells that rain down on man and machine alike.

This is not a scene from "Saving Private Ryan;" it is a well-choreographed exercise called Kernal Blitz Prime that pits Marines against a fictitious opponent. In addition to the amphibious assault, a major combat casualty exercise is underway as well.

As in any opposed amphibious landing, the medical elements that support these Marines are just as busy as the Marines themselves. Over the next few days, more than 600 "casualties" flowed through the first and second echelons of care, possibly making this the largest peacetime casualty management exercise in U.S. history. The medical personnel assigned to the organizations that see the patients first provided life-saving procedures to the critically wounded, and returned to duty those that could still wield arms against the enemy.

When a Marine is injured, "Call 911" is never heard. Instead the cry rings out "Corpsman Up," and the hospital corpsman responds despite the dangers. Navy personnel provide the organic medical care for all Marines in the form of unit hospital corpsmen, battalion aid stations, beach evacuation stations, and shock trauma platoons for first echelon care, and medical battalions and casualty receiving and treatment ships (CRTS) for second echelon care.

Last year, Kernel Blitz Prime was one of four separate exercises and experiments conducted under the umbrella of Kernel Blitz 99. Referred to by planners as "Spring Fling 99," the exercise consisted of four phases that began 10 March and concluded 30 April 1999. First, Urban Warrior, an advanced warfighting experiment, was conducted in the San Francisco Bay Area. Subsequent exercises, Fleet Battle Experiment Echo (FBE-E) and Littoral Lightning, tried technologies and strategies the Navy and Marine Corps team will need to function in the 21st century. Included was a "three-block war" concept. In such a war, forces must provide humanitarian assistance, peacekeeping/enforcement, and low- to high-intensity combat operations. This is the situation faced today in Kosovo and other regions. In addition to testing atypical warfare plans, the Navy and Marine Corps tested technologies that support other new warfighting concepts, including Netcentric Warfare, Littoral Battle Space Dominance, Littoral Battlespace Management, and Rapid Precision Targeting.

The final phase of "Spring Fling 99" was Kernel Blitz Prime. U.S. Marine Corps and Navy expeditionary forces tested their ability to operate in the littoral regions and project combat power ashore. More than 15 ships and 12,000 Sailors and Marines from southern California participated in the major amphibious landing exercise at Camp Pendleton, CA. Third Fleet and the First Marine Expeditionary Force (I MEF) conducted a regimental-sized amphibious assault at Camp Pendleton

Hospital Corpsmen from 1st Medical Battalion load trauma mannequins into a field ambulance.

to exercise I MEF's amphibious assault capability. Additionally, a second regimental landing team assault was simulated and, with naval aviation and surface ship fires, simulated a deep fight. Command and control of actual and simulated forces during the assault was directed by combined Third Fleet and I MEF staff aboard USS *Coronado*.

Navy Medicine's premier combat casualty care exercise, traditionally titled Charlie Golf One, was embedded within Kernel Blitz Prime. The goals of Charlie Golf One were to treat and evacuate no fewer than 490 simulated casualties over 5 days using all echelons within the continuum of care, including first echelon, battalion aid station (BAS) and shock trauma platoons (STP); echelon 2, surgical company and casualty receiving and treatment ship (CRTS); echelon 3/4, hospital ship and fleet hospital; and fifth echelon, Naval Hospital Camp Pendleton. Specific Charlie Golf One objectives included: train to our wartime mission; stand-up our full spectrum of medical capabilities; practice combat casualty care; and move casualties through the patient evacuation system.

What takes only moments to read about required months of planning. Though the exercise took place in April 1999, the planning began in the summer of 1998. Medical operational planning for the health service support portion of Kernel Blitz Prime commenced in earnest October of 1998. Crucial to the success of Charlie Golf One were weekly meetings hosted by the I MEF Surgeon that included medical representatives from all concerned parties. It was in these meetings that the nuts and bolts of the exercise medical play were worked out, and the many hours of discussion are testament to the complexity of an undertaking this big.

There were many organizations and medical representatives that contributed to the success of Charlie Golf One. Medical planners from many activities were represented, including the I MEF Surgeon, Third Fleet Surgeon, First Force Service Support Group, First Medical Battalion, First Marine Division, Fleet Hospital Operations and Training Command, Naval Medical Center San Diego, Naval Hospital Camp Pendleton, Commander, Amphibious Group Three, USNS *Mercy*, USS *Essex*, U.S. Pacific Fleet, and the U.S. Army Reserve Training Site B Medical, Camp Parks.

Medical and health service support activities during Kernel Blitz Prime focused on standing up and operating Navy medical units, and practicing combat casualty care. I MEF medical units that were exercised included a battalion aid station and regimental aid station with the 1st Marine Division, and a surgical company and two shock/trauma platoons under the auspices of First Medical Battalion.

Approximately 1450 hospital-based and Reserve medical personnel were activated and assigned under the aegis of the Medical Augmentation Program.

I MEF Surgeon staff managed a casualty actor platoon to moulage simulated casualties and trauma mannequins before insertion at echelon 1 and 2 facilities. This evolution required extensive staff work with the Third Fleet Surgeon, I MEF trainer and

evaluators, the U.S. Army Reserve Training Site B Medical, Camp Parks, who provided and managed 200 trauma mannequins, and the staff of Edson Range, where the casualty platoon was staged in barracks and an abandoned clinic facility. In conjunction with the control evaluation groups, the I MEF Surgeon facilitated insertion of casualty actors and trauma mannequins into the casualty stream. The U.S. Pacific Fleet Surgeon organized seven medical control evaluation groups to evaluate combat casualty care provided by first responders and echelon 1-4 facilities.

Simulated patients (USMC live actors and trauma mannequins) were inserted into the various medical echelons. Once simulated patients were inserted at a particular location, patient care was administered by organic medical personnel according to the needs of the individual casualty. The appropriateness of care was evaluated by control evaluation groups (medical umpires).

A simulated casualty receives treatment at Bravo Surgical Company during Exercise Kernel Blitz Prime..

Kernel Blitz Prime included a significant Joint Medical Operations B Telemedicine/Advanced Concepts Technology Demonstration (JMO-T/ACTD). In conjunction with Defense contractors and JMO-T/ACTD, Kernel Blitz Prime hosted several demonstrations of advanced medical equipment and data systems. Navy medical personnel participating in an amphibious landing exercise used handheld computers (Librettos) on the beach to collect medical data on simulated casualties. Patient data was subsequently transmitted to medical units in advance of the casualty's arrival. The Theater Medical Core System (TMCS) was demonstrated at all echelon 2 and above medical treatment facilities. TMCS enables visibility on medical capability and activity in an operational environment. Additionally, advanced medical work stations were demonstrated in the surgical company. Assessment of the JMO-T/ACTD technologies demonstrated during Kernel Blitz Prime is pending.

To facilitate patient movement through the continuum of care, I MEF Surgeon staff provided 2 days of medical regulating training for patient movement personnel. A medical regulating control center was established aboard USS *Essex*, and a landing force patient evacuation officer was co-located with the Direct Air Support Center. Nevertheless, communication was a significant problem for patient movement. In conjunction with various vehicle control centers, patient movement was coordinated via the medical regulating net. Patients were moved from shore to the *Essex* and many crossed-decked to the *Mercy* for more definitive care. Medical regulators subsequently coordinated movement of simulated patients and casualty mannequins from the *Essex* and *Mercy* to the casualty actor platoon at Edson Range. Simulated casualties were also moved from shore to the *Essex* via Landing Craft, Air Cushion (LCAC).

Medical personnel aboard USS *Essex* stood up four operating rooms and staffed a 60-bed ward. A medical regulating control center was established aboard *Essex*, and a landing force patient evacuation officer was co-located with the Direct Air Support Center. In conjunction with various vehicle control centers, patient movement was coordinated via the medical regulating net. Simulated patients were moved from shore to the *Essex* and many crossed-decked to the *Mercy* for more definitive care. Medical regulators subsequently coordinated movement of simulated patients and trauma mannequins from the *Essex* and *Mercy* to the casualty actor platoon at Edson Range. Simulated casualties were also moved from shore to the *Essex* via Landing Craft, Air Cushion (LCAC).

The *Mercy* staffed the vessel at the 250-bed level, requiring more than 700 medical personnel from Naval Medical Center San Diego. Beginning with 100 pre-staged simulated patients, the staff of *Mercy* managed hundreds of "casualties" during the exercise.

Reservists from Fleet Hospital Great Lakes activated a 100-bed ward and four operating rooms onboard the Fleet Hospital Operations and Training Command. Staffed by 303 medical personnel and 37 Seabees, the Fleet Hospital staff expertly managed 64 pre-staged casualties; several hundred simulated patients flowed through the Fleet Hospital in subsequent days.

At Naval Hospital Camp Pendleton, over 80 staff of Fleet Hospital Camp Pendleton activated their fleet hospital training set to receive a mixture of over 100 simulated casualties. After triage and treatment, simulated casualties were returned to the casualty actor platoon at Edson Range. During this evolution several training topics were covered and exercised, taking the staff and the training set through its paces for the first time. Naval Hospital Camp Pendleton additionally exercised their disaster plan.

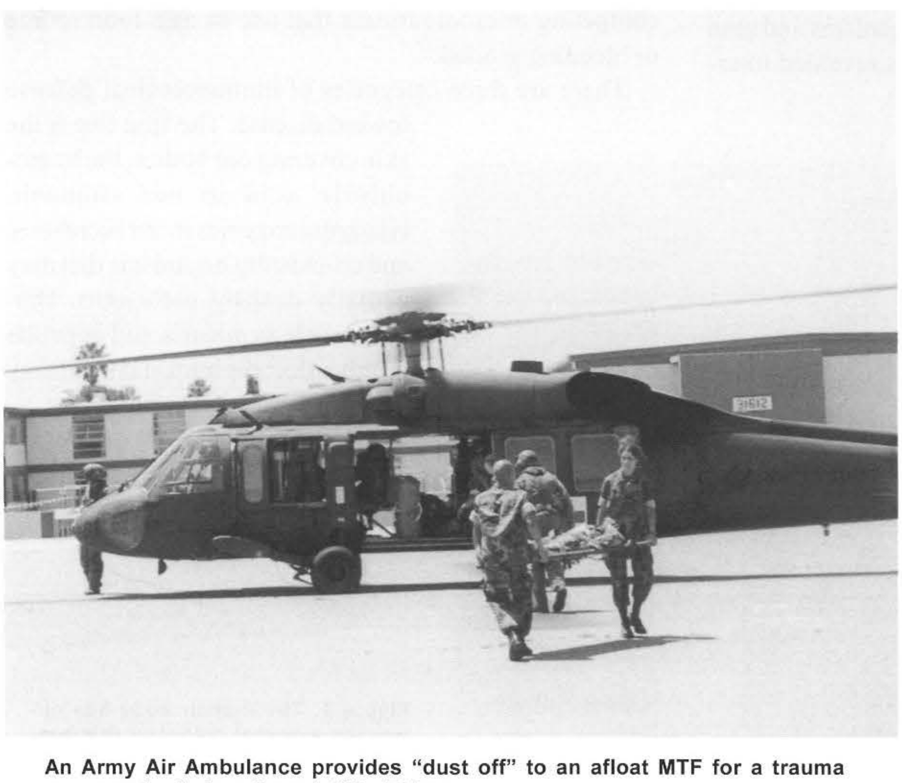
Conclusions

Medical planners from each of the medical platforms did a great job planning for their specific missions. The only planning shortfall was a Line perception that Charlie Golf One was a "Navy medical exercise" somehow not part of Kernel Blitz Prime. This perception led to difficulty effecting patient movement. Movement of simulated casualties stalled on occasion due to uncertainty concerning availability of transportation assets. Kernel Blitz Prime revealed the need to fully integrate the combat casualty care and patient movement process into exercise play.

Few problems were encountered throughout the exercise. Communications was a significant problem, especially with patient movement. Adequate medical personnel augmentation for the surgical company was a problem as well. The surgical company did not receive 24 of the 146 medical augmentees required to provide operational support for Kernel Blitz Prime. A significant portion of the 24 absentees were professional surgical staff. Their absence reduced the surgical capability of the surgical company by at least one-third. It is essential that all medical augmentees assigned to a surgical company train together as a unit.

All medical facilities established during Kernel Blitz Prime functioned marvelously well. Combat casualty care capabilities were exercised at all echelons of care; training was realistic and beneficial. Overall, the control evaluation groups found combat casualty care as successful. The casualty platoon at Edson Range did an outstanding job of processing and inserting simulated casualties. Six hundred eighteen simulated casualties were managed by the extensive medical system established in Kernel Blitz Prime.

Now that the dust has settled and the story of Kernel Blitz 1999 has been told, planners now must turn their attention to Kernel Blitz 2001. ❑



An Army Air Ambulance provides "dust off" to an afloat MTF for a trauma mannequin during Kernel Blitz Prime.

LCDR Lavender and LCDR Gray are medical planners on the staff of the Command Element, First Marine Expeditionary Force, Camp Pendleton, CA.

Feature

Space Sickness:
The Effects of Weightlessness on the Human Immune System

LT Joseph E. Ollivier,MSC, USNR

The evolution of humankind on our planet has gone through many adaptations. The most significant has been our adaptation to gravity. Although we do not realize it, all earthbound organisms have had to evolve in a gravitational field. Even aquatic creatures are not immune to gravitational effects. Subjecting earth organisms and man to reduced gravity or weightlessness has revealed interesting adaptations.

One of our more important concerns is whether weightlessness will impair our immune systems' ability to protect us against predatory microorganisms as we explore space. As with all organisms, we have developed sophisticated intrinsic systems that protect the human body from competing microorganisms that use us as a food source or breeding ground.

There are three categories of immunological defense toward disease. The first line is the skin covering our bodies, the hydrochloric acid in our stomach, lysozyme enzymes in our secretions, and co-existing organisms that may actually destroy pathogens. Diseases such as malaria and hepatitis B only infect the human body if they enter directly into the blood.

Internally, there are two other categories of immune response—

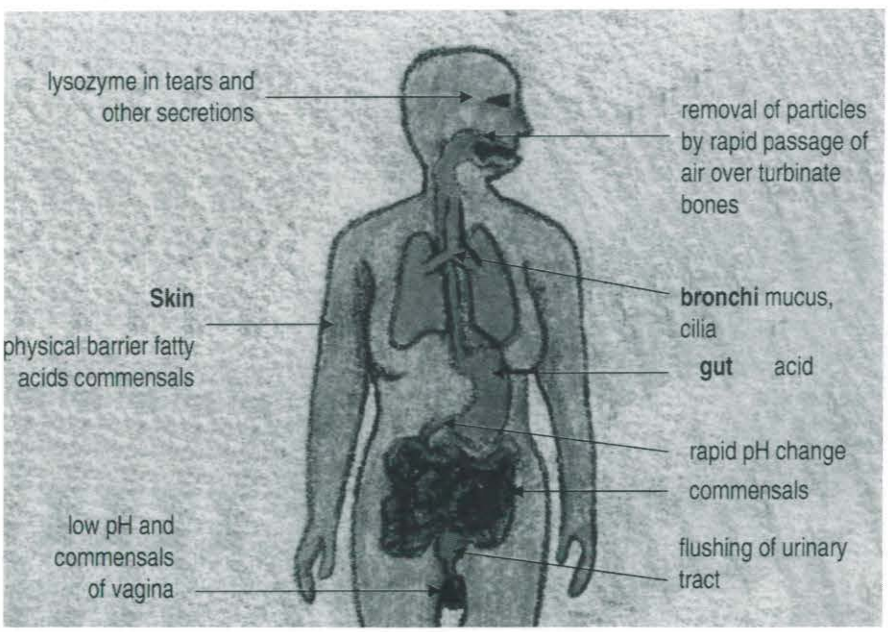


Figure 1. The human body has numerous external defenses that protect from pathogen entry.

the innate (natural) immunity and adaptive (acquired) immunity.(*1*) The innate depends on a variety of immunological responses that are neither specific for a particular pathogen nor improvable with repeated exposure to the same organism. In general, these are white blood cells (leukocytes) and proteins in the body that have evolved against certain pathogens.

Adaptive, or acquired immunity, helps the body defend itself against an invading organism it has never seen before.(*1*) Adaptive recognizes an invading organism, develops a specific immunological response to it, and then is able to retain in its memory the antigenic profile of the organism in the event the body becomes reinfected with the pathogen later. Such organs such as the thymus, spleen, and lymph nodes play an important role in this response. This acquired immunity is better recognized as the antibody—antigen response to infectious disease. Vaccine therapy utilizes acquired immunity to protect us against such threats as measles, tetanus, polio, and smallpox.(*1*)

While alterations in the immune system have often been documented in astronauts, understanding the etiology has lagged behind. We know there is a change in the differential white blood cell count in weightlessness. Phagocytic cells such as neutrophils increase in number while lymphocytes, eosinophils, and monocytes decrease.(*2-3*) There is a reduction in cell mediated immunity response and also delayed hypersensitivity response.

It appears that immunoglobulin (antibody) and complement levels are relatively maintained in weightlessness. The ratio between lymphocyte helper T-cells (CD4) and Cytotoxic T cells (CD8) is altered. Helper T cells that facilitate activation and proliferation of macrophages and B lymphocytes are increased. Cytotoxic T cells, on the other hand, decrease in number. These cells are responsible for detecting viral or parasitically infected cells and stimulating them to undergo apoptosis (cell suicide). NK (Natural Killer) cells also show a decrease in population. B lymphocytes, which transform into memory cells to retain antigen recognition and also produce antibodies, are equally found to have decreased in post-flight studies. Monocytes, another sub-population of white blood cells, show a decrease.(*2*) These cells are important in lymphocyte activation and also act as important regulators of the immune system through chemical mediators called cytokines.

All this has given evidence to the hypothesis that the cell mediated immune system is blunted in weightlessness. In the innate immune response, weightlessness actually increases the serum levels of certain complement proteins. The majority of these proteins are made by the liver, and certain ones play an active role in attaching themselves to pathogenic bacteria, allowing the bacteria in turn to undergo phagocytosis by polymorphonuclear neutrophils (PMNs). C3 complement protein levels seem to increase, whereas C4 complement proteins stay relatively unchanged.(*2-3*)

While studies are ongoing as to the effects of weightlessness on human immunology, there has also been preliminary research on bacteria's response to microgravity. Studies with *Escherichia coli* and *Bacillus substillis* indicate what appears to be an increased exponential growth in bacterial colonies in weightlessness when the bacteria are in suspension, whereas their counterparts on agar did not experience the same heightened cell growth under the same weightless conditions. It appears by the evidence that fluid dynamics and extracellular transports due to weightlessness and not cellular dynamics changes due to zero gravity may be the cause for increased microbial proliferation.(*4*) Alterations in cytoskeletal structure, and metabolic and mechanical changes may be transformed into biochemical responses that are not conducive to optimal survival.

In several studies a direct relationship exists between cytoskeletal integrity and apoptosis where there has been inhibition of actin filaments and disruption of microtubules in weightlessness.(*4*) In essence, when first generation based life forms are exposed to microgravity, the rudimentary steps to evolutionary adaptation begin all over again. Bacteria like humans most likely will find variations in their ability to function in space.

Scientists have long known that extreme environmental changes can have an adverse effect on the immune system. Different models have been used to try and simulate spaceflight microgravity. Bed rest has been widely used to mimic the physiologic effects of spaceflight. In some instances subjects were placed in a head down position.(*5*) Academic stress has been another test model used to evaluate functional changes in the immune system. Although both these models showed some promise in giving indications as to the human body's immune response in space, experimental results did not coincide consistently with what was actually found.

Perhaps the most useful model and the one that comes closest to being a factor in spaceflight is physical stress. Both Russian cosmonauts and US astronauts have used resistive motion devices, treadmills, and bicycle ergometers, to counter the effects of bone loss and muscle atrophy in weightlessness. Yet, it has been known for some time that moderate to extreme physical stress will suppress the immune system.(*5*) In fact, several studies have

shown similar results between ground-based physical stress experiments on the immune system and those seen in spaceflight studies. Increase in total neutrophils in peripheral circulation, decrease in natural killer cells, and cytotoxic/suppressor lymphocytes have been consistent in both areas.

Even reducing the atmospheric pressure has been shown to depress immunity. The earlier spaceflights from Mercury to Skylab typically used cabin pressures significantly less than the 1 atmosphere found on earth. Ground-based immunological studies have been conducted on test subjects at 3600 meters above sea level. These have shown

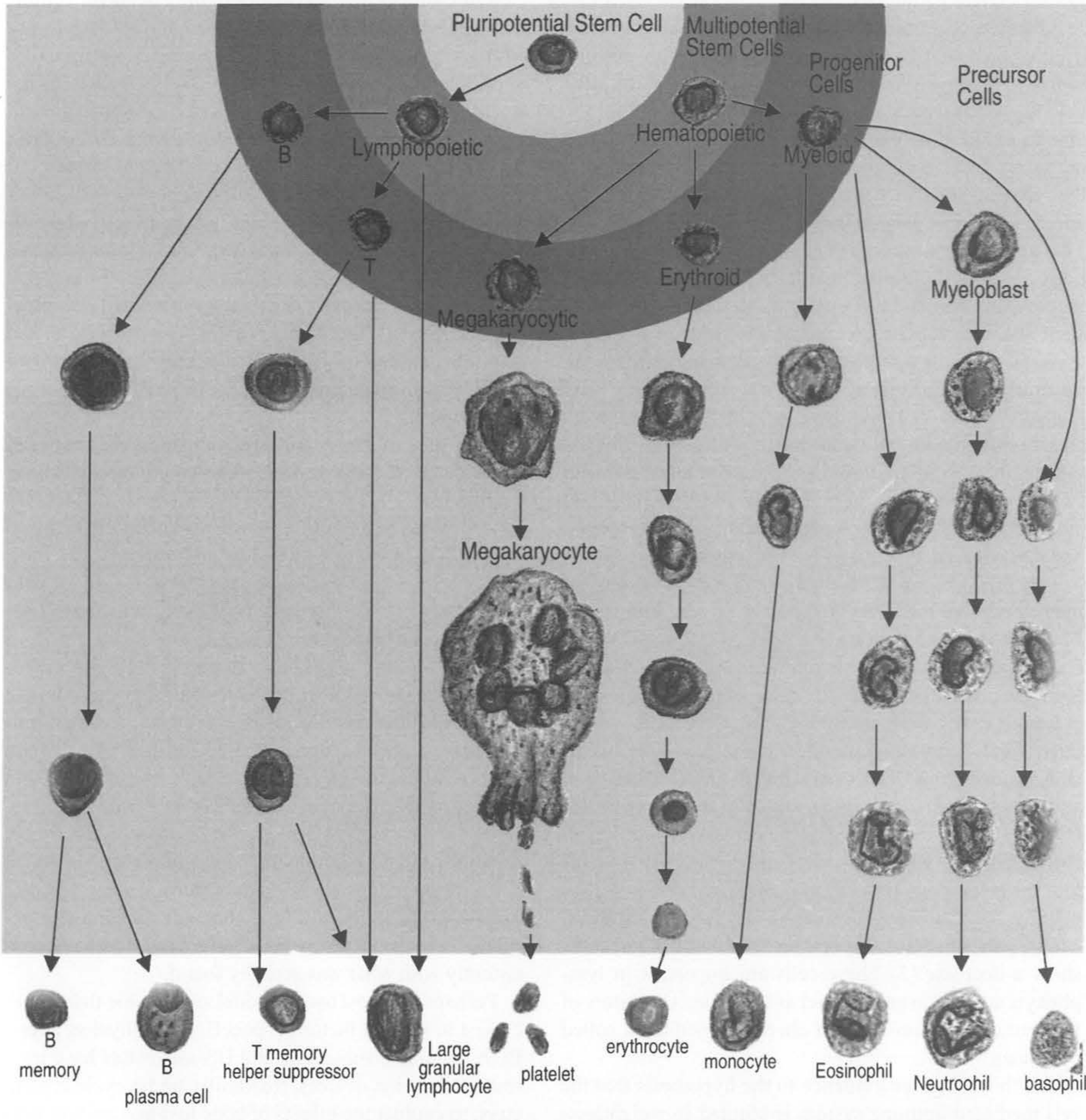


Figure 2. All red blood cells, white blood cells and platelets derive their origin from bone marrow stem cells. It is known that weightlessness affects human stem cell hematopoiesis. There is a significant suppression of erythropoiesis and myelopoiesis to such extent that growth potential of multilineage and particularly erythroid hematopoietic cells is altered.

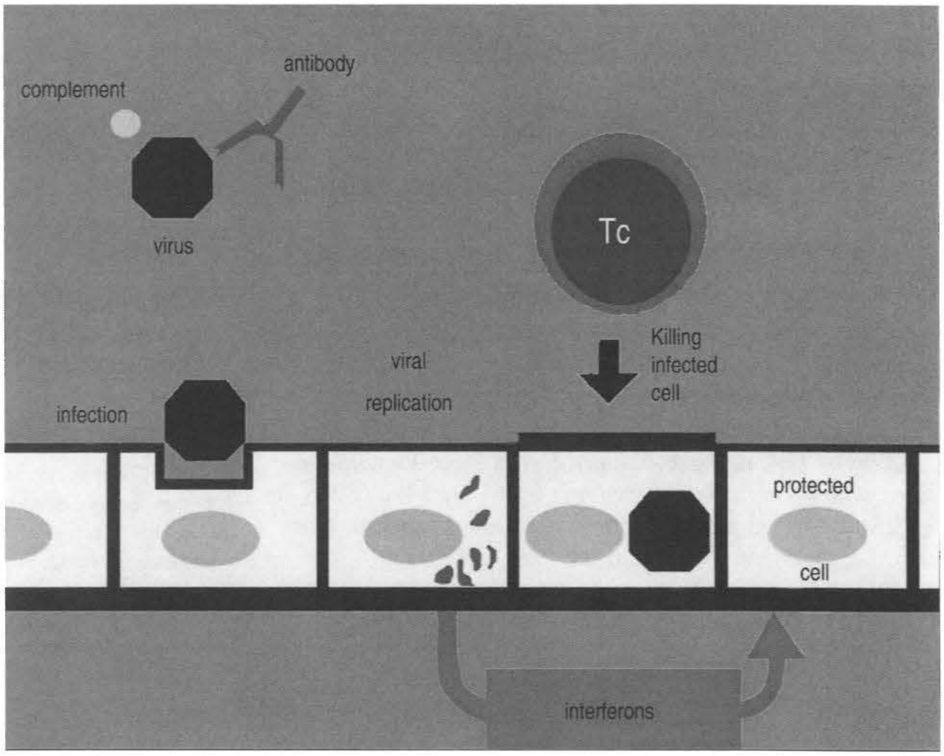


Figure 3. Complement and antibodies can work separately or in conjunction to clear the body of viral or bacterial infections. Cells in our body are capable of defending themselves, to some extent, from viral infection by releasing interferon that signal adjacent cells to initiate anti-viral defense mechanisms.

suppression in B and T lymphocytes consistent with those found in spaceflight.(*5*)

In the attempt to replicate the environment of space, scientists have shown that the human immune system is more sensitive to environmental changes than previously thought, and that variables can be multifactorial.

The Apollo program revealed that despite precautions, episodes of illness among crewmembers were not uncommon. Astronauts experienced pharyngitis (sore throats), upper respiratory problems, mild dermatological problems, viral gastroenteritis, rhinitis, and influenza. Microbial changes on astronauts' skin showed a reduction in saprophytes, with a proportionate increase in possible pathogenic microorganisms. The interior cabin surfaces also showed an increase in fungi and yeast during spaceflight.(*5*)

Conclusion

All scientific evidence to date indicates that human cellular immune mechanisms are altered or impaired during spaceflight. This means that aggressive pre-flight and interim flight monitoring will be paramount in ensuring the health of future crews. Long-term planning as with Space Station Freedom will help significantly in allowing scientists to monitor and study the effects of weightlessness on human immunology continuously. If humankind expects to colonize the moon, or voyage to Mars, we must know what the state of our health will be.(*6-7*)

Through research we now know that our immune system not only protects us from pathogenic microorganisms but also detects and destroys aberrant cells that have the potential to develop into malignant tumors. We know that tumors have multiple mechanisms for evading immune responses and that some malignant cells express antigens the immune system recognizes. Cytotoxic T cells are lymphocytes that help in this process but these cells are depressed during space flight.(*7*)

Medical research has confirmed that several endemic viruses in the human population have been tied to human cancers.(*8*) The Epstein Barr virus that causes infectious mononucleosis has been implicated in the pathogenesis of several lymphomas. The human Papilloma virus definitely causes squamous papillomas (warts) but are strongly suspected of causing several cancers, including cervical cancer.(*8*) Will the human immune system still be able to keep such viruses in check in a long-term weightless environment? Could this be a problem on the long trip to Mars?

Most of the questions presented but not yet answered by preliminary studies during the last 35 years of space exploration hopefully will be answered with the permanent manning of Space Station Freedom. Ongoing and

continuous monitoring of astronauts as the human models for long-term microgravity exposure along with more sophisticated equipment and instruments on board the space station will allow us more rapid detection of impairment or adaptation in the human body.

Slowly and methodically we will set up permanent residence in space and man will adapt and conform to that environment and survive. As a Roman general once stated "Anything that is possible has already been done. Anything that is impossible will be done tomorrow."

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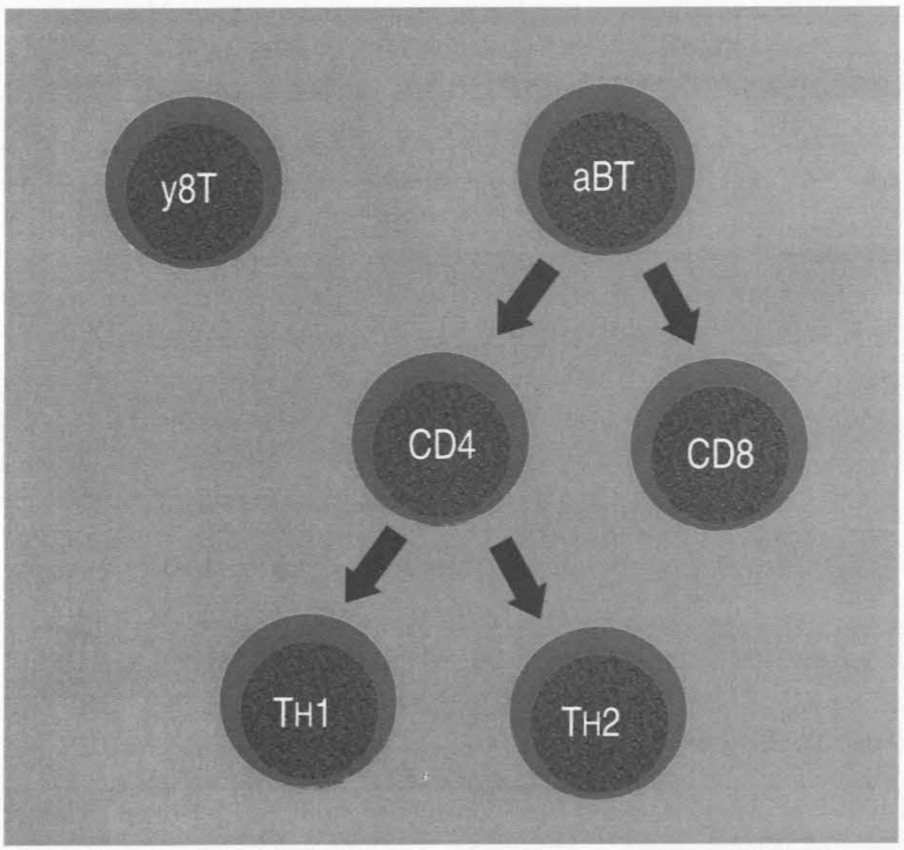

Figure 4. With prolonged weightlessness there is a shift in the population of T-lymphocytes. T helper cells (CD4) will increase in number and Cytotoxic T-cells (CD8) actually decrease in number. Cytotoxic T-cells (CD8) are the lymphocytes that recognize and kill cells that have become infected with intracellular pathogens (viral or bacterial), or may have turned malignant.

Competence to Make Medical Treatment Decisions

LCDR Stephen Talmadge, MSC, USN

Naval health care facilities are treating older patients in hospitals and clinics as the population of eligible beneficiaries gets older and DOD medical facilities treat more non-active duty beneficiaries. It is important to understand the concepts involved in capacities to consent to treatment. This article discusses competence to make treatment decisions, and fundamentals of how to assess competence. Assessments of decision-making capacity (clinicians) and competence to consent to medical treatments (courts) are treated synonymously in this article. Courts are the last resort in treatment situations.

Throughout the nineteenth and into the twentieth centuries, physicians generally did not undertake treatment without a patient's consent. This practice was founded on both Enlightenment philosophy and legal issues. Consent was inferred from a patient's passivity or evoked by incomplete or misleading descriptions of their conditions and the proposed treatment. Physicians withheld information when it might lead the patient to reject needed care. By the mid-nineteenth century, this "simple consent" approach was criticized, mostly by the courts. Court cases from 1955 to 1972 resulted in an approach that came to be known as "informed consent." The new "informed consent" had three elements that were integral to treatment decision-making: (1) disclosure of information (2) in a context allowing voluntary choice, and (3) made by a patient competent to decide. In the absence of any of these elements, consent is not valid, ethically or legally. This article discusses competence to decide.

In our society, particularly in the case of medical treatment, people have the right to make decisions that may lead them to harm. High regard for autonomous choice leads evaluation of another's competence to begin with a presumption of competence. Only if a person's ability to make independent decisions is so limited are they considered incompetent. Respecting individual choices is transgressed when decision-making capacity is too poor and concern for an individuals' welfare leads to alternative means of making choices on their behalf. Rules governing the assessment of competence reflect a balance between desires to protect persons from potentially harmful decisions and deeply held beliefs about the sanctity of individual choice.

When should patients' decision-making be assessed and who should perform the assessment? Ordinarily, most clinicians assess their patients' decision-making abilities during every encounter. This evaluation usually occurs unconsciously as clinicians take notice of patients' dress, demeanor, communicative skills, intelligence, ability to attend to conversation, and ability to reach a decision. Circumstances that alert clinicians to the need for a more formal evaluation include abrupt changes in patients' men-

tal states, patients' refusal of recommended treatment, patients' consent to especially invasive or risky treatment, and the presence of risk factors to impaired decision making. Once doubts arise about a patient's ability to make decisions, the treating clinician will often be the person best situated to conduct a more extended evaluation of the patient's capacities. Seeking an outside consultant should not necessarily be the immediate response. Whoever performs the evaluation should be aware of the legal and ethical basis for the rules governing decision-making competence, and be knowledgeable about mental status evaluation.

There are no cookbook procedures to guide assessment of competence to consent to treatment. Instead, understanding of the underlying concepts, like grasping the theoretical constructs on which clinical diagnosis is made, is essential. Although experts in mental health law commonly agree about the fundamental principles involved, these principles are neither obvious nor well known to many clinicians with limited experience in dealing with these questions.

Principles

Understanding the following principles helps answer questions about competence.

(1) Legal incompetence is related to, but not the same as impaired mental status. It is an obsolete premise that serious mental illness, mental retardation, or cognitive impairment, per se, renders a patient incompetent to consent to treatment. The patient who is psychotic, seriously depressed, or in a moderately advanced stage of dementia can be found competent to make some or all decisions. In other words, patients' autonomy to decide is not denied merely because of illness. Of course, there is a relationship between impaired mental states and legal competence. A finding of incompetence is rare absent a mental illness, mental retardation, dementia, or a physiologic/organic condition affecting mental and emotional functioning. Presence of mental disorder or cognitive impairment is usually considered a threshold question for the competence judgment.

(2) A judgment of incompetence should be based substantially upon the effects of the person's mental disorder. What are the patient's functional abilities, what is he or she able or not able to understand? Law has current standards that focus on understanding of information disclosed during informed consent, appreciation of the information for one's own circumstances, reasoning with the information, and expressing a choice.

(3) One of the law's basic considerations in competence is the person's functional abilities to meet the demands of a particular situation. Whether or not someone is considered competent will depend, in part, on the task they face. Until recently, the law tended to view individuals as either incompetent or competent for all purposes. Now there is wide acceptance that various decision-making domains are not necessarily equivalent. Competence for one purpose, but not another, is more likely to arise for patients whose deficits are not extreme or broad reaching. An extension of this reasoning is that within the realm of competence to make treatment decisions, individual clinical circumstances will vary in demands of the task. Competence, then, does not depend solely on a person's abilities, but on the interaction between the patient's abilities and the decision-making demands of the situation. There is no absolute level of ability that defines competence. An assessment of competence should not be based only on an investigation of the person's functional abilities.

(4) The evaluator must consider the consequences of a mentally impaired patient's decision. Individuals with mental conditions, likely to suffer harm as a result of their decisions, should be protected both from harm and from loss of their autonomy. Protection is achieved by adjusting upward or downward the degree of disability that is required in order to categorize them as incompetent. Thresholds of competence vary according to treatment situations. High benefit, low risk treatment; low benefit, high risk treatment; low to moderate benefit, low to moderate risk treatment illustrate the principle.

(5) Modern mental health law does not consider incompetence as an enduring status. It is important that decisions about a patient's competence be addressed periodically. Patients' cognitive and emotional states may fluctuate. Studies of some mentally ill patients have shown that capacities for treatment decision making improve significantly after admission. And deteriorating conditions may require reconsideration of the status of patients previously judged competent.

Functional Abilities

The four primary functional abilities involved in assessments for competence to consent to treatment are the ability to express a choice, the ability to understand infor-

mation relevant to treatment decision making, the ability to appreciate the significance of that information for one's own situation, and the ability to reason with relevant information so as to engage in a logical process of weighing treatment options.

When patients are unable to reach a decision or to indicate to caregivers what course of treatment they desire, courts and ethicists have uniformly considered them to be incompetent. If patients are unable to express a choice, usually there is no need to consider their status regarding other abilities. Conversely, it would be rare that a person will be considered competent to decide merely because they can state a preference. Patients who can speak, but are so ambivalent they can neither commit to a choice nor elect to assign the decision to someone else can be found incompetent.

Patients making decisions about treatment must have available to them the body of relevant information to comply with the informed consent doctrine. When patients' mental functioning seriously impairs their ability to comprehend, they fail to meet the understanding requirement for competence to consent. The psychological processes related to understanding are not easy to define. The person's general intelligence and understanding is clinically relevant (capacity), but not sufficient. The clinician should examine directly the degree to which the patient appears to have actually understood information in the disclosure itself.

Disagreement with physicians' characterization of the situation is not an adequate basis for concluding that someone is incompetent. An understanding of the information presented is not sufficient to conclude competence. Does the patient accept the relevance of their disorders or potential treatment consequences for their own circumstances? Courts have often asked whether patients acknowledge, or appreciate, that they are suffering from the disorder with which they have been diagnosed and whether they acknowledge the consequences of the disorder and of potential treatment options for their own situation. Sometimes persons understand the information about a specific disease and its specific treatment implications, and understand the cost-benefit analysis, but due to denial, distortion, or delusions, they believe that what they are told is not true for them. Non-acknowledgment of their illness or the relevant consequences of treatment options should be counted as a failure of appreciation only when patient's choices are based upon several factors. The patient's belief must be substantially irrational, unrealistic, or a considerable distortion of reality. This point does not question the choice; it questions irrational quality of the beliefs on which the choice is based. The belief must be the consequence of impaired cognition or affect. Not all irrational or illogical beliefs can easily be dismissed as lack of appreciation. (Religion is an example). Strange beliefs or even psychotic delusions that do not enter into the patient's reasons for deciding on a particular treatment are not relevant for appreciation.

Less than severe depression often presents considerable problems in competence assessments. Patients' expressions of hopelessness may be seen as reasonable reactions to patient's illnesses, when they may actually reflect depressed moods. "False empathy" can lead clinicians to accept decisions to forego medical treatment that are, in fact, of questionable competence. Because it is almost impossible to know the extent to which depression is affecting patients' appreciation, the best course may be to defer a decision about capacities while antidepressant medication is instituted.

If understanding and appreciation requirements have been met, capacity to logically manipulate information (reasoning) is the next consideration applicable to decision-making capacity. Reasoning pertains to potential irrationality in the processing of information, not in the content or propositions that are processed. It is possible to process irrational beliefs logically. One can fully appreciate various consequences of treatment, yet have problems using those beliefs logically when combining information to reach a decision.

The use of advance directives and substituted judgment protect patients' interests in controlling what happens to their bodies. We allow other people to make decisions on patient's behalf. Even then, patients' self-determination should be protected whenever possible. And, the rules and practices that have developed which exemplify the legal and ethical principles underlying competence to consent to treatment apply to all concerned. ❑

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Medical Readiness Training Just in Time

Dag K.J.E. von Lubitz, Ph.D, MD
CAPT Jay R. Montgomery, MC, USN
LCDR Warren Russell, MC, USN

The Human Patient Simulator offers a highly realistic platform for training diagnostic and therapeutic procedures.

Without continued stimulation, even already acquired diagnostic acumen wanes and manual skills falter.(*1,2,3*) Providing intellectually stimulating continuing medical education to medical personnel in remote regions continues to be one of the greatest challenges of modern medicine.(*4,5,6,7,8,9,10*) Numerous studies highlight the problem of "skills erosion" among medical personnel who do not have the periodic opportunity to sharpen their expertise in manual dexterity, rapid and correct diagnosing, triage, and even proficiency in medical leadership.(*11,12,13,14*)

Studies show that under acute and stressing circumstances, the lack of training or insufficiently maintained skills may lead to increased morbidity and mortality.. (*15,16,17,18,19,20,21,22,23,24*)

There are a great many similarities between a rural medicine doctor faced with a medical emergency, and a Navy medical officer or hospital corpsman at sea or in the field.(*25,26,27*) This "environmental similarity" provided the conceptual foundation for a pioneering teletraining experiment utilizing the latest computer training concepts.

The experiment was conducted jointly by personnel from the University of Michigan Emergency Medicine Modeling and Simulation Research Laboratory, the Bureau of Medicine and Surgery, and the Telemedicine Department of the National Naval Medical Center. The centerpiece of the experiment was the Human Patient Simulator (HPS, Medical Education Technologies, Inc., Sarasota, FL). The HPS consists of a computer-operated, life-size manikin capable of reproducing virtually all forms of disease and injury encountered by an emergency/

trauma physician. It offers a highly realistic platform for training diagnostic and therapeutic skills, procedures, drug treatment, and medical leadership and administrative skills.(*28,29,30*) The device reproduces exact physiological signs of a human in medical distress. It allows monitoring sounds of the chest and heart, permits analysis of blood gases, maintenance of airway, control of hypovolemia, administration of drugs and IV fluids, defibrillation, plus a host of other procedures commonly encountered in an emergency room or a ship's sick bay. All vital signs of the patient are faithfully reproduced on a standard ER monitor. The instruments (e.g., laryngoscopes, needles, chest tube, etc.) are the same as used on the clinical floor.

Modern HPS platforms are mobile and, with proper procedures, the preparations to transport an HPS, even over very long distances, can be a comparatively simple 1-2 hour exercise, even when large numbers of trainees are anticipated.(*31*) Deployment of the HPS human trainers is, however, a more complex evolution. All major medical training centers, military and civilian, place rigorous time demands on their teaching staff. Their availability for travel to remote regions is limited to very sporadic events. Hence, routine, high quality training by such personnel is virtually unattainable away from the parent institution. While the advent of Human Patient Simulators provided a part of the solution to the "remote region training dilemma," the problem of linking a very distant, forward-deployed HPS to an expert medical "coach" located at a major naval or civilian (typically university) hospital continues to pose a formidable obstacle. If a "remote control" solution could be devised, the training potential offered by HPS technology would increase tremendously for isolated medical practices. To demonstrate the feasibility of the recently developed innovations to the remote HPS control issue, the Medical Readiness Trainer (MRT) Unit of the University of Michigan(*32*) joined forces with senior naval medical experts from the Bureau of Medicine and Surgery.

The goal of the experiment was to demonstrate that the Human Patient Simulator could be successfully deployed to a very remote site, and still act as a teletraining platform for intensive practice of emergency/trauma medicine skills, e.g., ATLS, ACLS, etc. The essential technological aspects required for such an operation are: 1) the remote control of all simulator functions by an expert stationed hundreds or even thousands of miles away from the simulator itself; and 2) the capacity of the remote expert to view the trainees during a training session. Both problems were solved by using electronic interfaces developed by the MRT Unit and connecting the simulator-driving computer and its remote controlling device by means of standard telephone lines. Commercial off-the-shelf (COTS) technology provided real time video link. Functionally, this communications system allowed full control of the simulator, continuous transmission of vital signs monitor data, selectable view of the simulator, trainees, or both, and voice communications.

Medical Readiness Trainer in operation: the HPS unit is surrounded by the fully immersive, Hyper-Rich Virtual Reality (VR) environment (CAVE).

The participating physicians were located approximately 700 miles apart. The control group operated from the office at the Department of Telemedicine, National Naval Medical Center, Bethesda, MD. The simulator group was located at the Virtual Reality CAVE of the University of Michigan Media Union in Ann Arbor.

During the first exercise, the treatment of ventricular tachycardia served as the training scenario. The physicians in Bethesda served as the "instructors" for the "trainee" team in Ann Arbor. The next exercise was designed to demonstrate that an expert stationed at the simulator (i.e., at a major medical teaching center equipped with HPS platform(s)) can provide training in diagnostic and patient management skills by explaining and guiding the distant trainees through the essential "how to" skills of patient management and care. In this mode, the distant trainees can be repetitively drilled in triage, rapid diagnosis of unsuspected disorders, etc. HPS-based training aimed at the distant trainee group that has no physical access to the simulator is made possible by the HPS telecommunication links of the simulator. The remote trainee has, therefore, full access to the same information set that is available to the clinical expert operating the simulator, e.g., views of the vital signs monitors, blood gas status, chest and heart sounds, etc. The trainee can then be requested to provide initial diagnosis and develop initial management plans, followed by final diagnosis, recommendations for further management, transfer, and other elements leading to the definitive disposition. During this part of the exercise, the physician in Ann Arbor acted as a training expert exposing the "trainee" group in Bethesda to sudden, unexpected medical events (hypovolemic shock).

Finally, a "just in time" training scenario was devised. In this scenario, a remote expert located in Bethesda instructed a distant "junior physician at sea" (i.e., Ann Arbor) in the approaches necessary to save a critically ill patient (blunt injury caused by incorrect underway lowering of a ship's motor whaleboat).

The entire series of exercises had no precedence in the history of medical education and training. The results provided both a proof of concept, and the validation of the usefulness of Human Patient Simulator-based teletraining and its potential versatility. Importantly, the exercise demonstrated that coupling the HPS with remote computer interfacing devices offers probably the most desirable form of skills maintenance outside the "real life" emergency room or sick bay. It provides the trainees with a high degree of realism, allows introduction of different forms of stressors (e.g., unexpected medical complications, inadequate resources, time, etc.), and forces the trainee into the active "clinician" rather than the passive "student" pattern of behavior. The challenging, high paced, and rapidly (and even unpredictably) changing action environment of HPS-based training facilitates such transition. Importantly, though, the pace of a training session remains under full control of the remote expert who can readily adjust the level of intensity to that suitable to the proficiency (or educational comfort) of the trainees. Moreover, the scenarios can be exercised repetitively either in identical sets, or in sets that offer subtle variations and provide a didactically important element of reinforcement. The latter capacity allows the trainees to develop the capacity to think rapidly, plan ahead of the current status of the patient, and consider alternative plans of management. Finally, the exercise demonstrated that this new technology may offer other significant advantages, e.g., simultaneous training of a number of widely dispersed trainee groups, rapid access to prominent experts, and (significantly) a potential for the reduction of overall training costs.

Further operational studies using HPS alone or in combination with portable three-dimensional virtual reality viewing systems are currently underway, and the forthcoming results will be reported in this journal.

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Book Review

War and the Red Cross: The Unspoken Mission **by Nicholas O. Berry. St. Martin Press, New York. 180 pages, 1997.**

As NATO forces took their positions in Kosovo, they were joined by Non-Governmental Organizations (NGOs) that contributed to the humanitarian mission of serving civilians victimized by Serb forces. Elements of the 82nd Airborne and 26th Marine Expeditionary Unit encountered members of the International Committee for the Red Cross and other organizations like Doctors Without Borders.

As Navy hospital corpsmen and doctors are asked to engage in wide scale humanitarian efforts it is important that we understand the limitations, capability, and strategy of organizations that respond to human suffering whether that suffering is caused by man or natural disaster.

Nicholas Berry, a professor of international relations, has labored to explain the grand strategy of the International Committee of the Red Cross. Depending on the military mission, relief agencies often are willing to assist military forces with regional and medical intelligence that can contribute to a Joint Task Force's effectiveness. However, NGOs often are more than happy to relieve a military force of humanitarian supplies without wholly understanding the military's priority of force health protection. Still other NGOs may be totally reluctant to associate themselves with a military presence, as this would compromise their neutrality and safety in a hostile region.

This book is the first step toward understanding the complexity of humanitarian operations and explains the prime objective of the International Red Cross—making wars dysfunctional. The author explains how Red Cross doctrine has been applied in Rwanda, Yugoslavia, and Sudan. He also discusses the codes on humanitarian relief adopted by over a hundred NGOs at a 1993 conference in Birmingham, England.

The book explains the Red Cross's core values for humanitarian operations: Independence, Effectiveness, and Impact. The first describes independence from the United Nations' or the warring parties' political agendas. The Red Cross rationale is to preserve the organization's neutrality that allows it access to all victims of war. This delicate neutrality evaporated in Chechneya when the Red Cross hired the majority of its host-nation support from one tribe, which lead to kidnappings and the murder of aid workers in that region.

To maintain its effectiveness the Red Cross must be a clearinghouse for all NGOs participating in a war or disaster. In Rwanda, 120 NGOs were registered with the Red Cross. Impact involves efficiently using humanitarian supplies to care for as many victims as possible. The Red Cross also states that building on local capacities in the event of a disaster or war is a top priority and that victims need to be involved in the management of their aid.

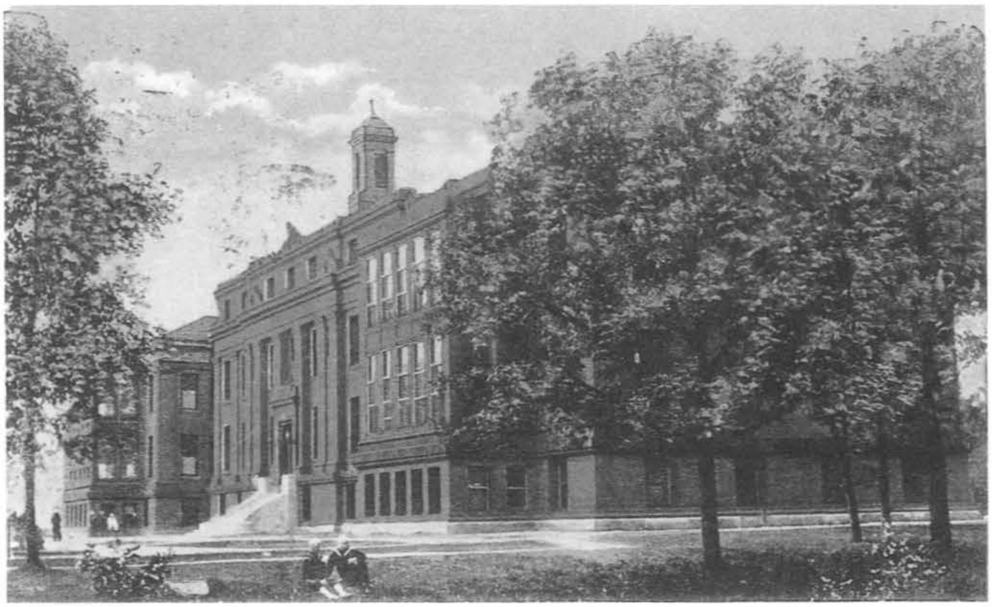
The first refugee to die in Kosovo after the Serb withdrawal was a land mine victim. Berry talks about the political agenda of the Red Cross with regard to banning the use of land mines and the gains made in Afghanistan, where local capabilities were exploited and a prosthesis factory built in that war-ravaged country.

The final chapters deal with post-cold war relief operations. Both military medical professionals and civil affairs units can learn from the dangers and problems encountered in Chechnya and Rwanda. There is a pattern to providing relief on a wide-scale and it typically begins with preventive medicine—ensuring safe water and food supplies.

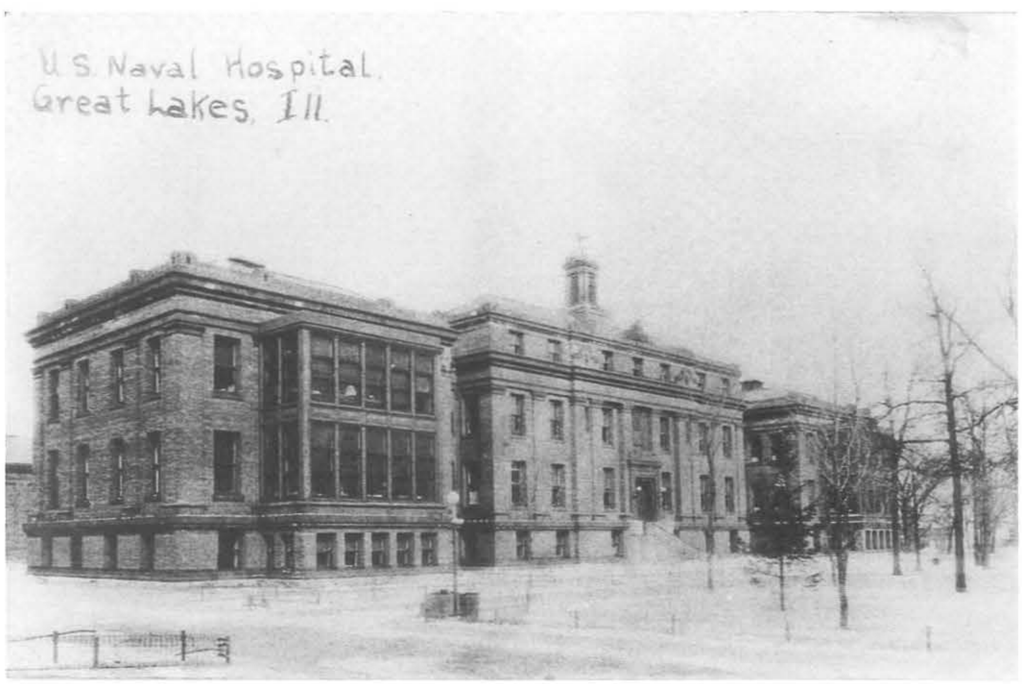
I have only one criticism. The book is primarily a political description of the Red Cross and does not delve deeply enough into the mechanics of providing aid on a large scale. Nevertheless, *War and the Red Cross* makes for good pre-deployment reading.

—LT Youssef H. Aboul-Enein, MSC, USN, is Plans, Operations and Medical Intelligence Officer, Naval Hospital Great Lakes, IL.

Navy Medicine 1918



Contemporary postcard views of Naval Hospital Great Lakes. Contributed by LT Robert E. Moberly, MSC, USN (Ret.), LT Roland Fahie, MSC, USN, and LT Youssef Aboul-Enein, MSC, USN



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